

Design & Analysis of E-2000 A.C Draw Works With Variable Frequency Drive

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ABSTRACT:

An oil rig is structure lodging hardware used to penetrate into underground stores for oil or gaseous petrol. It for the most part comprises of Mast and Sub-structure, Hoisting and turning types of gear. The lifting arrangement of an Oil Rig comprise of draw works, frequently called the crane, the derrick or pole, the crown square, voyaging piece and the penetrating line (wire rope). The framework is utilized to lift penetrate stem and packaging amid the way toward making opening and coating it the crane itself is a lifting specialist. The draw works is a unique reason winch of an Oil Rig, which is utilized for attracting and out, the packaging channeling, boring tools and other gear utilized as a part of the investigation of oil. From the preparatory information gathered, the power factor of the drive can be kept up over 0.7 even at bring down paces inferring that the responsive power is diminished to a huge degree when contrasted with the DC engine drive where in the power factor falls as below as 0.35. Another part of the VFD is that the speed of the engine can be kept up at 0 RPM to unending time without danger of potential harm to the internals. Another imperative part of air conditioning Engines is that the power utilization would be relative to the prerequisites as observed from the power factor estimation of 0.7 min. The same isn't the situation for DC engines – The engines would wear out in a limited capacity to focus time. Variable recurrence drive has preferred standpoint of expanded speed go at steady voltage. The present work conceives new mixture fluffy controller for an immediate torque control. Consequently, to beat the above issues, an endeavor has been made in this task for the outline and advancement of air conditioning Draw works with variable recurrence drive framework. The fundamental target of the outline alteration of air conditioning Attract Works is to build the productivity by supplanting the chain and sprockets with outfit box, with a view to make the framework conservative and furthermore to lessen its cost and weight. The plan of the draw works would take after from the premise of existing outline prilimarily, with stamped changes coming about by the use of air conditioning power stack with shifting torque speed parameters. The impression of the attract works is conceptualized to be relatively littler, which would call for enhanced materials

Keywords: Draw works, Oil Rigs, Design, Analysis

1. INTRODUCTION:

Man's custom of diving gaps into the earth is accepted to be as old as progress itself. One can sensibly assume that his requirement for drinking water would have caused pre-notable man to scoop out despondencies in streambeds, looking for water amid a drought. With the improvement of better hand instruments, such sorrows or openings would be more profound and more profound.

An oil fix is structure lodging gear used to bore into underground repositories for oil or flammable gas. The term can allude to a land-based structure, or a marine-based structure (oil stage) normally called a ' Seaward Oil Apparatus' While marine-based apparatuses can penetrate through the sea base for oil or petroleum gas, the innovation and financial matters of under-ocean isn't yet economically practical.

Fundamental standards in diving an opening in the earth are:-

1. Break up the earth in burrowing by utilizing a bit with descending push.
2. Removal of the cuttings from the opening by utilizing persistent stream of liquid.

The oil rigs are predominantly of two sorts viz.,

1. On-shore rig: It is implied for boring ashore
2. Off shore rig It is implied for penetrating on oceans and seas

In the year 1975-76 B.H.E.L was begun to fabricate of oil rigs with the co-appointment of Joined Conditions Of America Produce scope of B.H.E.L oil rigs incorporates

- E-760-fit for boring up to 3,650 Meters.
- E-1400-fit for boring up to 4,900 Meters.
- E-2000-fit for boring up to 6,100 Meters.

Present day rotating penetrating apparatuses a large number of huge amounts of drills stem or packaging by utilizing a rule of material science used a large number of years back. The prior derrick, windlass, was a basic flat drum around which rope was wound. Men turned the drum with a wrench and could lift stacks significantly heavier than they conventionally could have. As requests for lifting heavier burdens expanded with the progression of time, men started searching about for control substantially more prominent than human quality to turn the drum for early rotational boring; they utilized steam motors for this power. At show they utilize diesel motors and electric engines however the essential standard of increasing mechanical favorable position in taking every necessary step of lifting keeps on lying at the premise of raising.

The raising of an Oil Rig comprise of draw works, frequently called the crane the derrick or pole, the crown piece, voyaging square and the boring line(wire rope) the framework is utilized to lift bore stem and packaging amid the way toward making opening and covering it the lift itself is a lifting operator. It comprises of

1. A extensive spinning drum around which the boring line is spooled.
2. A arrangement of apparatuses, grips, brakes, chains and pulley to transmit and control.
3. A auto shaft on which feline heads and regularly a sand reel are mounted.
4. The driller's control.

Since the draw works is an extremely costly piece of boring apparatus gear, every part is to be developed with more noteworthy exactness and what it does as such that they can work and keep up it well. The essential piece of draw work is a solid inflexible casing work that can be promptly moved starting with one apparatus side then onto the next. Casing works are composed by makers to with stand huge curving and bowing burden put upon them amid penetrating they more likely than not been made to affirm tow laws in regards to measure for development on high ways, vast draw works are part in equal parts principle drum on the front half transmission and the feline shaft at the back other than the edge work the draw work incorporate transmission drum brakes feline shafts and control its assistants incorporate feline heads sand reel and helper brakes here and there it has an associated counter shaft to drive the revolving table power for running the draw works wants the apparatuses prime mover meaning its fundamental power estimate more apparatuses utilized inside ignition motor as prime Their energy is transmitted by methods for a segment of a mechanical drive fix. On an electrical drive fix their energy drive generator which thus control electric engine to run the different electric parts of the

apparatus. Thus, an endeavor has been made to plan and advancement of A.C. Draw works with variable recurrence drive, centering at ideal proficiency, extensive variety of velocities, minimal effort, conservative, and upkeep free with ideal existence of air conditioning draw works. Every one of the parts of the winch viz, drum, drum shaft, course and supporting plate are composed utilizing expository formulae and results are introduced.

2. LITERATURE REVIEW:

*Jan Artymiuk*¹ another idea penetrating raising frameworks 2006 proposed two new outlines from the traditional lifting framework. The first is the Sea Hydrodynamics A.S RamRig© penetrating idea, in light of pressure driven chambers as actuators fueled by up to 3.4 MW of water powered power in a shut circle water driven framework The second is another land fix idea in light of a protected rack and pinion drive framework with another age of apparatuses which can in a split second switch between the work over, boring and the scoring activities. A.Walid² etal, Displaying and Reproduction of a Dynamic Hurl Remunerated Draw-works. Suggested that, a hydro-mechanical idea containing the primary parts of the draw-works and lifting rig were demonstrated. Ankit Verma³ Substitute Power And Vitality Stockpiling/Reuse for Boring Apparatuses: Lessened Cost And Lower Discharges Give Lower Impression to Boring Activities Explored on exchange penetrating vitality sources which can make boring procedure monetary and naturally benevolent

3. THEORY:

Draw works (winch) is a mechanical gadget that is utilized to twist up a rope or wire rope (additionally called link). In its least difficult frame it comprises of a spool and connected wrench. The spool can likewise be known as the winch drum. More intricate plan outlines have adapt assemblies and can be powered by electric, hydraulic, pneumatic or internal combustion drives. Some may include a solenoid brake and/or a mechanical brake or ratchet that prevents it from unwinding. Besides industrial applications (e.g.in cranes), winches are used for towing cars, boats, or gliders. There are several winches on almost every boat or ship where they are used to pull anchor or mooring lines, halyards, and sheets. The rope is usually stored on the winch, but a similar machine that does not store the rope is called a capstan. When trimming a line on a sailboat, the crew member turns the winch handle with one hand, while tailing (pulling on the loose tail end) with the other to maintain tension on the turns. Some winches have a "Stripper" or cleat to maintain tension. These are known as "Self-tailing" winches. Winches are frequently used as elements of backstage mechanics to move scenery in large theatrical productions. Winches are often embedded in the stage floor and used to move large set pieces on and off

3.1 Working Subtle Elements Of Draw Works

A completely repetitive draw works is furnished with two finish and absolutely free frameworks for controlling and fueling the drum and drum shaft of the draw works. Every framework comprehensively involves slightest one wellspring of power(e.g., an engine or motor), a power transmission implies, ideally of the rigging or chain compose, and a few methods for mechanically coupling the power source, transmission and drum shaft together. Every framework may likewise be given a brake implies, for example, at least one circle band, electric or water-cooled brakes. If any segment of either framework fizzles, the completely repetitive draw works still can raise penetrate pipe from a borehole and in this way maintain a strategic distance from the danger of a "Stuck" bore pipe. This unit is known as "DRAW WORKS". The name has originated from the essential capacity of the gear – it draws, i.e. it is a Derrick. Draw works is the boss of revolving rig. The draw works is a crane of exceptional outline, which execution a no. of fundamental working rotating boring activities. Its image name, model or ostensible limit is frequently used to assign or distinguish the specific apparatus size of which is a section. A draw works for use with a penetrating apparatus, containing: a mounting base; a left rigging transmission gathering secured to the mounting base and having an authority outfit drive and a first and a moment various speed equip transmission, the gatherer adapt drive being coupled to the first and second different speed equip transmissions; a correct rigging transmission get together secured to the mounting base

and having a gatherer adapt drive and a first and a moment numerous speed equip transmission, the authority equip drive being coupled to the first and second various speed equip transmissions. Electrical draw works are accessible in 4 models. Covering a penetrating profundity extend from 2100 meters to 9000 meters. The models E-3000,E-2000,E-760 depend on field demonstrate OIL WELL plan where as the E-1400 has been created for the middle of the road go profundity. The engines have an ABS-endorsed outline and are designed from similar ideas utilized for GE'S cargo train footing engines. The engines' overwhelming obligation outlines assimilate the high torque and beating of boring conditions. Frame twisted twisting with Class H protection and twofold VPI application give prevalent assurance from voltage spikes. A high-quality, rotor gathering, including copper-chromium-combination rotor bars and brazed end-turns, expands the rotor get together's unwavering quality and life. The low-latency rotor improves draw-works execution with responsive speeding up, diminished breaking time and less squandered vitality.

The real outline targets for every one of the models of Draw Works are

1. Productive POWER TRANSMISSION: Guaranteed by utilization of straightforward power stream framework using amalgam steel shafts, roller heading, solidified sprockets and oil washed chains.
2. Lessened Administration TIME: Accomplished through simple availability of grease focuses. Brake change and examination covers.
3. HIGH Unwavering quality: Guaranteed by keeping up ideal similarity of all segments in addition to sufficient hold limit of grips and brakes

4. OIL RIGS

The oil rigs mostly delegated four composes

1. Deep drilling rigs
2. Mobile rigs
3. Work over rigs
4. Desert rig
- 5.

4.1 Deep Drilling Rig

The drilling extent for the Profound penetrating rigs will be 3500-9000m. They are grouped into 4 composes.

- E-760(3600m)
- E-1400(4900m)
- E-2000(6100m)
- E-3000(9000m)

4.2 Mobile Drilling Rigs

The range of drilling depth is 2000-3000m. The mobile rigs are classified into 3 types.

- SM-450(1500m)
- M-750(2000m)
- M-900(3000m)

4.3 Work Over Rig

The range of drilling depth will be 3500m to 6000m. They are of two capacities.

1. 450-S (5500m)
2. M-500 (6100m)

4.4 .Desert Rig

The range drilling depth for this type of rig will be 3500 m to 4000m.

5. MATHEMATICAL FORMULATION FOR DESIGN OF A.C. DRAW WORKS

The design is done for the different parts of the Draw work viz., Drum, drum shaft, and Housing plate. Each DRAW WORKS containing VFD Controlled Air conditioning engine fueled. The entire draw works mounted on overwhelming obligation oil field compose slide with embellishments reasonable for boring oil/gas wells to profundity run 6000 Mts with 5" bore pipe.

5.1 Specifications:

Rated Horse Power: 2000 HP Minimum

Drive Motors: Two AC motors, each of 1400 HP intermittent rating explosion proof motors.

No. of Drums: Single

Drum size: 32"x56"

Grooving: Grooved for 1-3/8" casing line.

Hoisting speed: Direct gear drive

Brake: Two 60" or above diameter Air cooled Disk Brake with Locking device

Inertia Brake: Locking device.

Auxiliary brake: Regenerative type braking system.

Crown & Floor Saver system: Electronic system for preventing accidental hitting of crown blocks or rig floor by the travelling block and pneumatic crown-matic type crown saver system

5.2 Drum:

The drum is the core of the lifting framework. It spools up and lets out boring line, raising or bringing down the voyaging piece and subsequently landing the position of lifting done. Modern drums differ in measure, contingent upon the profundity rating of the penetrating apparatus. The distance across must obviously be bigger for more prominent lengths of penetrating line. The barrel shaped surface is scored for effective spooling; a wedge formed gadget at the spines facilitates the line over for its arrival wrap. The ribs are wide to suit the mechanical brake groups that cover them. Components of the drum that get the best wear are fire solidified for solidness.

Output = efficiency * input

The torque available at the motor is

$$P = \frac{2\pi NT}{60}$$

$$\text{Torque acting on the drum } T = \frac{60P}{2\pi N} \text{ N-m}$$

The maximum shear stress due to the torsional load is given by

$$\tau_{\max} = \frac{\tau_{yt}}{\text{factor of safety}} = \frac{\sigma_{yt}}{2 * \text{factor of safety}}$$

The bending stress due the weight of Rotary, Swivel, and drill bit is given by

$$\sigma_b = \frac{32M}{\pi[D^3 - d^3]}$$

Then, the maximum shear stress due to Bending Moment and Torsional Moment according to Maximum Shear stress theory is given by

$$\tau_{\max} = \frac{1}{2} \sqrt{\sigma_b^2 + 4\tau^2}$$

But

$$\tau_{\max} = \frac{16}{\pi[D^3 - d^3]} \sqrt{M^2 + T^2}$$

$$\tau_{\max} * \frac{\pi}{16} [D^3 - d^3] = \sqrt{M^2 + T^2}$$

Assuming the factor of safety as 2

The material used for drum is Silicon Carbide

Yield Strength = 21 Gpa

Youngs Modulus = 700 Gpa

As a thin cylinder

$$f = \frac{pd}{2t}$$

$$p = \frac{\text{maximum load}}{\text{lateral surface area}}$$

$$\text{Circumferential stress} = \frac{\text{yield stress}}{\text{factor of safety}}$$

For thick cylinder

Circumferential or hoop stress for internal pressure zero and external pressure p_r

$$f_r = -p_r \left[\frac{2R^2}{\sqrt{R^2 - r^2}} \right]$$

5.3 Shaft Design

The shaft design utilized as a part of draw works is through shaft. For design the shaft is accepted as just upheld bar with consistently appropriated stack. Torque is being transmitted to shaft by equip which will be additionally exchanged to empty drum fitted on this shaft and subsequently this shaft happens to be the significant individual from add up to gathering in exchanging the torque

$$T_e = \sqrt{M^2 + T^2}$$

$$\tau_{\max} = \frac{\pi}{16} * d^3 = \frac{1}{2} \sqrt{\sigma_b^2 + \tau^2}$$

5.4 Plate Design

This piece of the outline happens to be the supporting plate to the entire housed parts in draw works. The quantity of plates is two set on the either side of shaft gathering which will take up the heaps similarly. As the aggregate unit of draw works is mounted on the supporting plates the thickness of this part is considered and outline of this part is done expecting it to be a basically upheld shaft.

$$\text{Deflection of the beam } y = \frac{wl^3}{48EI}$$

6. RESULTS AND DISCUSSIONS

6.1 Results

From the above design calculations the dimensions of the various parts presented.

Dimensions of the drum $D = 812.9 \text{ mm}$

$d = 812.15 \text{ mm}$

$t_d = 0.325 \text{ mm}$

Maximum Shear stress on Drum = 5250 N/mm^2

Diameter of the Drum Shaft $D_s = 275 \text{ mm}$

Plate thickness $t = 30 \text{ mm}$

6.2 Discussions

Considering the hollow drum by taking both the torsion and twisting load the internal width of the drum is 812.15 mm and the thickness is 0.37 mm. the drum being empty, to compute its thickness considering the drum as thin chamber we got a thickness of 0.05 mm and when we considered it as a thick barrel the figured thickness is 0.03 mm as this thickness is less for the drum to manage the on coming burdens so we are dismissing this thickness. From the above outcomes the thickness is taken as 0.37 mm

The diameter of the shaft is gotten as 275 mm

For housing plates the deflection is 0.047 mm for 30 mm thickness

As the thickness expected is between as far as possible we are thinking about the plate to be safe

7. CONCLUSION

The design has been adjusted and the last investigation of AC draw works demonstrates that the AC draw works is inside as far as possible. The measurements of the drum shaft and the spool drum and the diversion of the lodging plate is adequate. The altered outline did for E-2000 Oil Rig with the required highlights has been assessed

8. REFERENCES:

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